

WHAT IS CLAIMED IS:

1. A method of performing failure analysis upon a multi-layer semiconductor
5 device, comprising the steps of:

exciting a gain medium containing molecular fluorine and disposed in a resonant
cavity to generate an output beam having a wavelength around 157 nm; and

directing the output beam onto a multi-layer semiconductor device to selectively etch
away material therefrom.

2. The method of claim 1, wherein the semiconductor device includes a top layer
containing SiO₂, at least a portion of which is etched away by the output beam to expose a
layer of material located underneath the top layer.

3. The method of claim 1, further comprising the steps of:
shaping the beam into a pattern using a mask; and
imaging the shaped beam onto the semiconductor device.

4. The method of claim 3, further comprising the step of:
attenuating the output beam before the output beam reaches the semiconductor device.

5. The method of claim 4, wherein the attenuating step includes introducing an
optical element into the output beam that transmits only a portion of the output beam.

6. The method of claim 4, wherein the attenuating step includes introducing a
photoabsorbing gas into the output beam that transmits only a portion of the output beam.

7. The method of claim 4, further comprising the step of:
homogenizing the output beam before the shaping step to create a symmetrical cross-
section of the output beam.

8. The method of claim 4, wherein the exciting step includes generating red 718 nm energy in the output beam, and wherein the method further includes the step of imaging the red 718 nm energy onto the semiconductor device.

5 9. The method of claim 3, further comprising the step of:
viewing the etching of the material using a camera aligned co-linearly with a final trajectory of the output beam.

10 10. A failure analysis system, comprising:
a resonant cavity;
a gain medium containing molecular fluorine and disposed in the resonant cavity;
a power supply for exciting the gain medium to generate an output beam having a wavelength around 157 nm; and
15 an imaging system that directs the output beam onto a multi-layer semiconductor device to selectively etch away material therefrom.

20 11. The failure analysis system of claim 10, wherein the imaging system comprises:
a mask for reshaping the output beam; and
an objective lens for imaging the reshaped output beam onto the semiconductor device.

25 12. The failure analysis system of claim 11, further comprising:
an attenuator disposed in the output beam for attenuation thereof before the output beam reaches the semiconductor device.

13. The failure analysis system of claim 12 wherein the attenuator includes an optical element that transmits only a portion of the output beam.

30 14. The failure analysis system of claim 12 wherein the attenuator includes a photoabsorbing gas that transmits only a portion of the output beam.

15. The failure analysis system of claim 12, further comprising:
a beam enclosure surrounding the output beam that provides a sealed path for the
output beam between the resonant cavity and the semiconductor device.

5 16. The failure analysis system of claim 11, further comprising:
a homogenizer disposed in the output beam before the mask to create a symmetrical
cross-section of the output beam.

10 17. The failure analysis system of claim 10, wherein the excited gain medium
further produces optical energy in the output beam having a wavelength around 718 nm, and
wherein the imaging system images the 718 nm energy onto the semiconductor device.

15 18. The failure analysis system of claim 10, wherein the imaging system further
comprises a camera mounted substantially co-linearly with a final trajectory of the output
beam for viewing the etching of the material.

19. A method of performing failure analysis upon a multi-layer semiconductor
device, the method comprising the steps of:

20 exciting a gain medium containing molecular fluorine and disposed in a resonant
cavity to generate an output beam having a wavelength around 157 nm;

directing the output beam onto a multi-layer semiconductor device that includes
integrated circuitry covered by a passivation layer, wherein a portion of the passivation layer
is etched away by the output beam to expose the integrated circuitry.

25 20. The method of claim 19, wherein the passivation layer contains SiO₂.

21. The method of claim 19, further comprising the steps of:
shaping the beam into a pattern using a mask; and
imaging the shaped beam onto the semiconductor device.

22. The method of claim 21, further comprising the step of:
attenuating the output beam before the output beam reaches the semiconductor device.

23. The method of claim 22, wherein the attenuating step includes introducing an
optical element into the output beam that transmits only a portion of the output beam.

24. The method of claim 22, wherein the attenuating step includes introducing a
photoabsorbing gas into the output beam that transmits only a portion of the output beam.

25. The method of claim 22, further comprising the step of:
homogenizing the output beam before the shaping step to create a symmetrical cross-
section of the output beam.

26. The method of claim 22, wherein the exciting step includes generating red 718
nm energy in the output beam, and wherein the method further includes the step of imaging
the red 718 nm energy onto the semiconductor device.

27. The method of claim 21, further comprising the step of:
viewing the etching of the material using a camera aligned co-linearly with a final
trajectory of the output beam.

28. A method of etching a passivation layer formed on a semiconductor substrate
using a beam of radiation having a wavelength of 157 nm generated from a molecular
fluorine laser comprising the steps of:

directing the beam of 157 nm radiation towards the passivation layer; and
selectively removing a portion of the passivation layer using the directed beam.

29. The method of claim 28, wherein the passivation layer contain SiO_2 , and
wherein a layer of material located underneath the passivation layer is exposed by the
selectively removing step.

30. The method of claim 28, further comprising the step of:

shaping the beam into a pattern using a mask, wherein the directing step includes imaging the shaped beam onto the semiconductor device.

31. The method of claim 30, further comprising the step of:
attenuating the beam before the beam reaches the passivation layer.

32. The method of claim 31, wherein the attenuating step includes introducing an optical element into the beam that transmits only a portion of the beam.

33. The method of claim 31, wherein the attenuating step includes introducing a photoabsorbing gas into the beam that transmits only a portion of the beam.

34. The method of claim 31, further comprising the step of:
homogenizing the beam before the shaping step to create a symmetrical cross-section of the beam.

35. The method of claim 30, further comprising the step of:
viewing the removal of the passivation layer using a camera aligned co-linearly with a final trajectory of the beam.